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GAS ABSTRACTS

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1. GAS INDUSTRY

LP-Gas Sales

LIQUEFIED GAS SALES SOAR TO MEET DEMAND. *World Oil* 127, 176 (1948) *February.*

A table showing the marketed production and distribution of liquefied petroleum gases for the years 1922 to 1947 is given.

L. Ciboch

LP-Gas Sales

Thomas, R. W. and Rugh, K. W. LP-GAS SALES GAIN 30 PER CENT IN 1947. *Petroleum Engr.* 19, 94, 96, 98, 100 (1948) *January.*

See *Gas Abstracts* 4, 23 (1948) *February* for abstract.

Liquid Hydrocarbon Reserves

Deegan, C. J. TOTAL LIQUID PROVEN RESERVES HIT NEARLY 26 BILLION BARRELS. *Oil Gas J.* 46, 170-173 (1948) *January* 29.

A summary is given with tables to show the proven U. S. reserves of liquid hydrocarbons and natural gas as of January 1, 1948. It is stated that both the liquid and gaseous hydrocarbons proven reserves of the United States are at an all-time high. Tables show the reserves by state, reserves of 1948 compared with 1947, and ratio of reserves to production. The data are tabulated by groups of crude plus condensate, other natural-gas liquids, and natural gas.

L. Ciboch

Mineral Production

U.S. MINERAL PRODUCTION IN 1947. *Am. Gas J.* 168, 31-32 (1948) *February.*

A brief review of the 1947 mineral production of the United States as announced by the Bureau of Mines is given. The total value of production increased 40% over that of 1946 while the physical production increased 13%. The marketed production of natural gas was almost 10% over the 1946 total making a new record of 4,400 billion cubic feet.

L. Ciboch

Natural Gas Production

NATURAL GAS PRODUCTION TO EXCEED 1947's RECORD 4.4 TRILLION FEET. *World Oil* 127, 170-173 (1948) *February.*

During 1947, 5370 miles of pipe line were added to the country's network increasing the capacity by nearly 2 billion cubic feet daily. Tables and graphs showing the natural gas production and value for the years 1918-1947, natural gas reserves and consumption and the years' supply in reserve for the years 1918-1947, recoverable reserves by states, and marketed production by states and years, are included.

L. Ciboch

Natural Gasoline Production

Casper, J. C. NATURAL-GASOLINE AND CYCLING PLANTS WILL BREAK OWN RECORD IN 1948. *Oil Gas J.* 46, 181-182 (1948) *January* 29.

Tables showing the production of natural and cycle products by states and for the years 1941-

1947 are presented. The 1947 output of LP-gas was 280% greater than the 1941 production. The rapidly increasing demand for LP-gas and the pressure for conservation of natural gas are given as the basis for an estimated light-hydrocarbon production by natural-gasoline and cycling plants of 16,800,000 gal. daily; the record-breaking 1947 production was 15,030,000 gal. daily. However it is predicted that the total potential demand in 1948 will not be satisfied.

L. Ciboch

Natural Gasoline Production

NATURAL GASOLINE OUTPUT GOING UP FOR 16th YEAR IN ROW. *World Oil* 127, 174-175 (1948) *February.*

It is indicated that production of natural gasoline and allied products will be expected to average about 385,000 barrels daily in 1948. Tables showing the production by states and years 1911 to 1947 are given.

L. Ciboch

Pipe Line Construction

Poole, M.E. 10,000 MILES OF PIPE LINE CONSTRUCTION PROBABLE IN 1948. *World Oil* 127, 211-212, 216, 218, 220, 222, 224, 226, 231 (1948) *February.*

It is expected that about 10,000 miles of new line will be completed in 1948. At the end of 1947, approximately 5257 miles of lines were under construction and 8534 miles were authorized. Data are given for product, gas, and oil lines. A detailed list of pipe line activity in 1947 giving data for each company is included.

L. Ciboch

Pipe Line Construction

Reed, P. 23,707 MILES OF NEW LINE, FOREIGN AND DOMESTIC, SEEN FOR 1948-51 PERIOD. *Oil Gas J.* 46, 190-191 (1948) *January* 29.

Pipe lines laid in the United States in 1947 totaled approximately 8,130 miles, of which 4, 785 miles was for natural-gas systems; it is predicted that construction in 1948 will be greater. Projected future plans, mostly for the 1948-51 period, total 17,606 miles for domestic and 6,101 miles for foreign projects. Tables showing the major projects and indicating the company, miles, inch, status and location are given.

L. Ciboch

2. APPLIANCES

Aerated Burner Flames

Culshaw, G. W. and Garside, J. E. RECENT STUDIES OF AERATED BURNER FLAMES. *Institution of Gas Engineers Communication No.* 325 (1947) *November.*

This report contains an extensive survey of recent literature on the subject of aerated burner flames together with a discussion of all controversial issues. Support to the theory that ignition velocity is a physical constant is given by the theory of interdiffusion at the inner cone base and by the excessive temperature at the tip. The ignition velocity is known to be dependent upon temperature, pressure, mixture composition, and turbulence. The existence of turbulent flow as given by Reynolds number is said to increase the ignition velocity of a combustible mixture. The dependence of ignition velocity on the initial temperature of the mixture has, as yet, not been satisfactorily ex-

plained. For some gaseous mixtures a hyperbolic relationship exists between the dead space and burner diameter. (Dead space being the area between the burner tip and the bottom of the flame). It is known that dead space varies with pressure, mixture composition, and burner diameter and that burner diameter has an effect upon flame thickness. It is expected, therefore, that these latter factors, i.e., flame thickness and burner diameter, will be investigated under the IGR Fellowship program in an effort to derive a mathematical function for ignition velocity.

E. F. Davis

Burners

HIGH STABILITY GAS BURNERS. *Coke & Gas* (*British*) **10**, 21-24, 33 (1948) *January.*

A discussion of new developments in the design of gas burners for domestic and industrial appliances is given.

E. F. Davis

Pin-Hole Burner Design

Jessel, R. and Hindley, H. R. FACTORS IN THE DESIGN OF PIN-HOLE GAS BURNERS. *Gas J.* (*British*) **253**, 56, 59-60, 65-67 (1948) *January* 7.

See *Gas Abstracts* 4, 25 (1948) *February* for abstract.

3. COMBUSTION AND INDUSTRIAL FURNACES

Boiler Efficiencies

Segeler, C. G. BOILER EFFICIENCIES WHEN USING GAS. *Heating, Piping, Air Conditioning* **20**, 83 (1948) *February.*

A table is given showing boiler efficiencies with variation in flue gas temperature, percent excess air, and type of gas.

E. F. Davis

Gas Burner

Kinney, S. P. HOT BLAST STOVE GAS BURNER GIVES SOFT MELLOW FLAME. *Blast Furnace Steel Plant* **36**, 217-219 (1948) *February.*

A soft flame is produced by controlling the aeration of the burner. This is done with an Askania control which operates louvers at the air intake. To prevent overheating of the stove dome a timing device connected to the Askania control will allow excess air into the stove at regular periods. The excess air will tend to maintain a cool dome if the time interval is properly adjusted.

E. F. Davis

Gas-Diesel Engine

Darling, R. A. ECONOMICS OF GAS-DIESEL ENGINE. *World Oil* **127**, 174-176, 178 (1948) *February.*

Some cost data are provided for gas diesel en-

gines. It is indicated that the improved four stroke cycle engine will require about 7 cu. ft. of natural gas per Hp per hr. A curve of fuel consumption vs. per cent load is given for oil diesel, gas diesel and spark ignited gas engines.

J. D. Parent

Gas Turbine

Smith, R. H. SELECTION OF HIGH TEMPERATURE MATERIALS FOR GAS TURBINES. *Iron Age* **161**, 56-60 (1948) *January* 22.

A critical review of the factors governing the selection of materials for gas turbine components is presented in this article. Oxidation and corrosion resistance, load-carrying ability, structural stability, and fatigue strength and ductility at elevated temperatures, are some of the general requirements discussed and evaluated. The problems encountered in selecting the best material for a component in the gas turbine are also considered from the metallurgical as well as economic standpoint, embracing the use of castings, forgings and bar stock.

Author's abstract

4. CARBONIZATION AND GASIFICATION

Catalytic Reforming of Hydrocarbons

Riesz, C. H., Batchelder, H. R. and Lurie, P. C. CATALYTIC REFORMING OF HYDROCARBONS. *Am. Gas Assoc. Monthly* **30**, 17-22 (1948) *February.*

Results of a pilot plant study of a peak load gas generating process are presented. One modification of the proposed method comprises production of a relatively low gravity carrier gas by catalytic reforming of propane or butane with steam and air followed by cold enrichment to the desired heating value with propane or butane. Catalytic reforming of refinery propane proceeded with negligible carbon deposition at the following conditions: six mols of steam per mol of propane, 1.0 to 1.5 mols of air per mol of propane, 1850°F. and propane space velocity of 165 cubic feet of propane per hour per cubic foot of catalyst. At these conditions, about 1400 cubic feet of carrier gas are produced per hour per cubic foot of catalyst. Reformed gas, composed in large part of hydrogen and carbon monoxide, had heating values ranging from 270 to 320 and specific gravities varying from 0.5 to 0.6, under suitable operating conditions. Utility requirements to make a 520 B.t.u., 0.7 specific gravity, peak load gas are estimated. The work is part of the research program sponsored by the Gas Production Research Committee of the American Gas Association. The pilot plant study (Project CPR-IC) was carried out by the Institute of Gas Technology in the Tilghman Street gas plant in Chester, Pennsylvania, of the Philadelphia Electric Company.

C. H. Riesz

Coal

Stacey, G. W. COAL—ITS CONSTITUTION AND UTILIZATION AS A CHEMICAL RAW MATERIAL. *J. Inst. Fuel* (*British*) **21**, 80-88 (1947) *December.*

The author believes that further rapid progress in the utilization of coal can come only after a better understanding of the fundamental structure of this raw material. Present knowledge regarding the molecular structure of coal is reviewed and included in the discussion is a brief summary of present day and future ideas for utilization of coke, coal tar, and coal gas.

C. Von Fredersdorff

Oil Gasification

Lewis, J. B. GASIFICATION OF OIL IN HORIZONTAL RETORTS. *Gas World* (*British*) 128, 138-139 (1948) *January* 24.

As an emergency measure oil was gasified by injection in horizontal retorts at Harrowgate, England. At 1560°F. and seven gallons of oil per hour in each retort, production was about 1 M.c.f. per hour per retort of a gas of 590 B.t.u. and 1.03 specific gravity (some combustion products leaked in because of the condition of the retorts). Yield was about 0.9 therms per gallon (oil efficiency about 64%). Coke for fuel amounted to 5.6 lbs. per M.c.f. Close temperature control was required since large amounts of lamp-black were formed at high temperatures.

H. R. Batchelder

Oil Gasification

Miller, R. GAS OIL GASIFICATION IN HORIZONTAL RETORTS. *Gas Times* 53, 382, 384, 385 (1947) *December* 19.

Possible ways of utilizing oil in gas works indicated by the author are: (1) in horizontal retorts where moulded sections are in use, (2) enrichment of blow gas in carburetted water gas carburettors, (3) enrichment in carburetted water gas generators. The first method was chosen, the principle advantage being that oil carbonization yields a gas of little or no H_2S content, thus causing no additional load on the purifiers. The process originally developed by the Gas Light and Coke Co., which consisted of atomizing oil through a narrow angle "Lucas" jet mounted on a burner tube supplied with a steam-air mixture was adopted at first but later discarded due to erratic control and coking of the jets. Modifications led to the use of low pressure steam for inspirating air and oil into the retort chambers with a resultant simplification of equipment, ease of oil control, and economy in steam consumption. Approximate calcalculations show 90,000 B.t.u./gal. converted to gas. The character of the tar was not altered when spraying oil and a gas of very low H_2S was indicated. The gas, however, was of a burning quality lower than normal coal gas. Points of control are discussed.

C. Von Fredersdorff

Refractories

THE BEHAVIOR OF REFRACTORY MATERIALS IN CARBONIZING PLANT: OBSERVATIONS IN CONTINUOUS VERTICAL RETORTS. *Gas J.* (*British*) 252, 582-586 (1947) *December* 10.

Examination of the condition of refractory brick of the carbonization chamber of a number of continuous vertical retorts in which the charge was "frozen" by introduction of water to the heating flues disclosed, in general, that: (1) serious disintegration of the high quality firebrick (sometimes siliceous brick) occurred near the top of the retort, (2) vitrification and crazing of refractory developed near the bottom of the firebrick zone, (3) fluxing agent attack followed by erosion attack due to gravity flow was noted in the lime-bonded silica zone, "blister" formation occurred at the bottom of this zone, (4) erosion attack and relatively slight slag attack developed in fireclay zone at bottom of retort, (5) slag impregnation varied from a negligible amount in the firebrick zones to complete penetration through the retort wall in the silica brick zones. Depth of carbon attack along the height of the chamber in the 1945 Bow Common Experiment is discussed.

C. Von Fredersdorff

Heaton, E. THE BEHAVIOR OF REFRACTORY MATERIALS IN CARBONIZING PLANT. *Gas J.* (*British*) 252, 639-640, 643 (1947) *December* 17.

A continuation is presented of a previous arti-

cle in which results of the 1945 Bow Commons Experiment are considered in detail. The major results of this work indicate disintegration of the firebrick and siliceous material from 0 to 1-1/2 ft. from the top of the retort and slag attack and flaking of lime-bonded silica and siliceous material in the lower sections of the retort. Disintegration of refractory near the top of the retort is probably due to the concurrent action of volatile slagging agents, carbon impregnation and unevenness of temperature due to erratic travel of charge. Evidence is cited supporting the hypothesis that flaking of lime bonded silica is due to differential expansion between scurf and refractory. A discussion of slag attack is included.

C. Von Fredersdorff

5. NATURAL GAS AND NATURAL GAS CONDENSATES

Acidizing Procedure

Clason, C. E. ACIDIZING PROCEDURE. *World Oil* 127, 148, 150, 152, 158 (1948) *February.*

The author attempts to put acidizing on a logical basis by presenting some fundamental chemical and hydraulic data.

J. D. Parent

Ammonia Demand

Farson, B. WHAT ANHYDROUS AMMONIA DEMAND MEANS TO BUTANE-PROPANE INDUSTRY. *Butane-Propane News* 10, 79-82, 85-86 (1948) *February.*

Anhydrous ammonia is now being applied directly in the earth as a fertilizer by means of plow teeth fixed to a tractor. The ammonia supply tank is carried on the rear of the tractor and connected by flexible tubing to the plow teeth. LP-gas men could easily distribute the ammonia in much the same way as they distribute LP-gases.

Abstractor's Note: Brass and copper cannot be used in an anhydrous ammonia system since the ammonia attacks the metals at a very rapid rate and causes "sessional cracking".

E. F. Davis

Casing Leak Detection

Martin, W. F. DETECTION AND REPAIR OF CASING LEAKS. *Petroleum Engr.* 19, 103 (1948) *January.*

A novel device for detecting casing leaks is described. It is supposed to reduce the cost of repair 75%. It is claimed that the device may also be used for detecting leaks in multiple line river crossings where leakage is taking place in one of the lines buried in the river bank.

J. D. Parent

Centrifugal Compressor

Karassik, I. PROCESS ENGINEER'S GUIDE TO THE CENTRIFUGAL COMPRESSOR.—IV. *Chem. Eng.* 55, 118-121 (1948) *January.*

The author gives simple formulas for calculating compressor requirements and temperature rise during compression.

J. D. Parent

Condensate Production and Cycling

Jones, P. J. CONDENSATE PRODUCTION AND CYCLING—PART 13—WHEN TO STOP CYCLING. *World Oil* **127**, (1948) *February.*

The influence and degree of cycling on ultimate recovery of oil and gas for the case of pressure maintenance with water is treated.

J. D. Parent

Cycling

Bennett, E. O. CYCLING AT HIGH PRESSURE VS. DEPLETION AND CYCLING AT LOW PRESSURE. *Petroleum Engr.* **19**, 120, 124, 126-128, 130 (1948) *January.*

See *Gas Abstracts* **3**, 207 (1947) *December* for abstract.

Dual Completions

Hofer, T. P. CORING DUALLY COMPLETED WELLS. *Petroleum Engr.* **19**, 111-112 (1948) *January.*

A discussion of new equipment for more efficient production of dually completed wells is presented.

J. D. Parent

Gasoline Plant Design

Middlebrook, V. E. SOME HIGH POINTS IN GASOLINE PLANT DESIGN. *Oil Gas J.* **46**, 98, 102-104 (1948) *February* 12.

The type of gas being processed has a strong effect on process design when the methane and ethane contents of a very rich gas are as low as 50 and 15% respectively. Absorption is not required and 85% butanes can be recovered by a combination of compression, refrigeration and flashing if pressures of 300 to 350 psi and temperatures of 0 to 15°F. are used. Increasing recovery by increasing absorber pressure leads to increased methane and ethane recovery. If a lower temperature is used in preference to this, less of these lighter components are absorbed for a given recovery of the key component since the equilibrium constants for C_3^+ decrease more rapidly with lower temperature than do those of methane and ethane. Further expensive added compression is not required. Refrigeration can be applied to inlet gas and/or oil or intertray cooling. Increased oil rate is also more favorable than increased pressure, but is not as favorable as chilling. Of course, intertray chilling is less effective as the absorber pressure is increased due to the decrease in latent heat as the critical condition is approached. Most modern plants are designed for 90 to 95% recovery of butanes and 45 to 60% of propanes. Ordinarily the most economical absorber pressure is in the range of 180 to 500 psi where cycling is not involved. For increased recovery it is necessary to operate stills at 80 to 100 psi in order to reduce the quantity of non-condensibles to be handled. An undue amount of stripping steam is required unless increased still bottom temperatures are employed, say 450 to 500°F. Direct-fired heaters for rich oil to the still is recommended (cracking is to be avoided). The most difficult plant problem is the increased load of non-condensibles. If dual stills are used, the primary unit may operate at 125 to 200 psi and the secondary at 40 to 60 psi. In such a case all of the recycle vapor is taken from the first unit and it is subjected to recompression, reabsorption or both. In any event the problem is to eliminate as much methane and ethane as possible and to retain as much C_3^+ as possible. Reabsorbers generally operate in the range of 40 to 125 psi. Intertray cooling is highly recommended in

such equipment. For old plants, depropanizers normally cannot be operated at pressures in excess of 250 psi so that incomplete condensation of overhead results so that a small deethanizer must be used in conjunction at a pressure of about 425 to 475 psi. It is often considered good practice in new plants to deethanize the entire raw make, feeding the bottom product to columns operating at successively lower pressures. Deethanizer pressure is that required to give a methane-ethane reflux containing a minimum of propane. It is limited by the critical point of the overhead product in the former case and by the critical point of the bottoms in the latter case. When water cooling is used considerable propane is condensed while little is condensed if the top of the column is chilled.

J. D. Parent

Middlebrook, V. E. SOME HIGH POINTS IN CYCLING PLANT DESIGN. *Oil Gas J.* **46**, 100, 102 (1948) *February* 19.

The elementary theory of retrograde condensation is presented. Cycling is defined as the process of recovering liquid hydrocarbons from single phase reservoirs existing under conditions of temperature and pressure above the critical point of the reservoir mixture. The term is declared to be a misnomer since it improperly suggests immediate return of injected gas to the producing well. It is pointed out that except for some distillate or high boiling liquid being produced the process is similar to that for natural gasoline production, the principal difference being the greater pressure employed. Fluid to the process is at a pressure in the range of 2,000 to 3,500 psi and at a temperature of 140 to 160°F. Absorption pressure lies in the range of 1,500 to 2,000 psi, although pressure in excess of 1,800 psi is seldom used due to complications arising from retrograde phenomenon. Increased pressure means less oil to be pumped and greater absorption, but abnormally great amounts of methane and ethane are absorbed and some oil is lost by retrograde vaporization. Other complicaations arise. Thus, due to the increased absorption of light components the effective oil to gas ratio is increased. This is somewhat offset by the adverse effect of increased pressure on equilibrium constants of the heavier components. Thus, K values for propane-and-heavier constituents increase rapidly at pressures in excess of 2,000 psi. To avoid undue oil loss, an oil of greater molecular weight is used, but this has an adverse effect on absorptivity, heat transfer coefficients and pump requirements. Further stagewise pressure reduction of rich oil to flash off a maximum amount of light components and a minimum of heavier components must be practiced.

J. D. Parent

LP-Gas

Findlay, R. A. FROM THE GROUND UP. *LP-Gas* **8**, 114, 116, 142-146 (1948) *February.*

Obtaining LP-gas from the ground is not a simple operation according to the author. Methods of detecting air pools, of drilling wells and handling the gas and oil from the well are discussed in detail.

E. F. Davis

LP-Gas Handling

Kintz, G. M. STUDY FUEL CHARACTERISTICS TO BE SAFE. *Butane Propane News* **10**, 89-90 (1948) *February.*

A general discussion is given of the safe practices in handling LP-gas. They should be stressed by all distributors.

E. F. Davis

Pressure Maintenance

Parks, E. K. PRESSURE MAINTENANCE AND CYCLING PLANTS . . . INCREASE

RECOVERY. *World Oil* 127, 138, 140, 143, 144 (1948) *February.*

Pressure maintenance is defined as a program of gas injection into reserves containing oil or condensate or both under which the pressure of the reservoir is kept as high as practical. Reasons for use of such a program are reviewed in detail such as control of edge-water encroachment, favorable effect of gas on oil viscosity and surface tension, prevention of retrograde condensation, etc. The purpose of the article is to establish lower production cost and greater recovery when pressure maintenance is employed.

J. D. Parent

Transmission

Miller, B. GAS TRANSPORTATION SYSTEM CALCULATIONS PART III—NO. XXI IN A SERIES. *Gas Age* 101, 27-34 (1948) *February* 5.

Elementary considerations relating to the calculation of minimum work required for compression are presented.

J. D. Parent

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

Catalyst Evaluation

Wright, S. R., Dimock, W. R. and Davis, S. G. EVALUATION OF CATALYSTS USED IN THE SYNTHESIS OF HYDROCARBONS. *Can. Chem. Process Ind.* 32, 53-54, 57 (1948) *January.*

The catalyst evaluation apparatus at the University of Alberta is described. There are six duplicate units, capable of operation at atmospheric or at 100 lbs. per sq. in. Catalyst preparation, conditioning and testing procedure are presented. Yield data for three cobalt: thoria: magnesia: kieselguhr (100:6:12:200) catalyst preparations are given.

C. H. Riesz

Fluid Catalytic Cracking

Trainer, R. P., Alexander, N. W. and Kunreuther, F. FLUID BED CATALYTIC CRACKING PLANT. *Ind. Eng. Chem.* 40, 175-182 (1948) *January.*

The features of a 5 gal/hr. fluid catalytic cracking pilot plant of the Shell Oil Company, Inc. are described. The steel and Transite building is 30′ x 40′ at the base and is 40′ high. The floor plan of the building and a flow sheet of the process are given. The 6″ diameter reactor is provided with a stripping leg which also serves as a standpipe. The reactor operates at 850-950°F. while the regenerator operates at 1000-1100°F. No cooler is provided for the regenerator, the heat of combustion of coke being dissipated by radiation. The cracked products from the reactor are sampled and evaluated on laboratory stills, rather than have continuous product fractionation of the total product. The complex system of instrumentation which maintains a proper pressure balance between the reactor and regenerator is explained. The catalyst rate is controlled by slide valves, the details of which are given in a drawing, and the rate is estimated by a carbon balance around the regenerator. Drawings are given for an instrument line catalyst trap, and for a device to obtain catalyst-free gas samples, both of which depend on the use of stone filters for their operation. Stone filters are also used to separate the catalyst from the effluent gases of the reactor

and of the regenerator. The operation is around-the-clock and three men per shift are required. The analytical testing work engages 3-6 men per day. The work is planned by two engineers together with a group leader and the pilot plant supervisor. The steps taken to start operation are given. The principal data which are taken are listed and a brief description is presented of the types of studies for which the pilot plant has been useful.

M. J. Merwin

Hydrocarbon Synthesis

Latta, J. E. and Walker, S. W. COMMERCIAL APPLICATION OF HYDROCARBON SYNTHESIS IN THE UNITED STATES. *Chem. Eng. Progress* 44, 173-176 (1948) *February.*

The Hugoton hydrocarbon synthesis plant planned by the Stanolind Oil and Gas Company is described briefly. The plant is rated at 6000 barrels per day of hydrocarbons, 80% of which is premium gasoline (clear A.S.T.M. octane, 80). Approximately 420,000 pounds per day of oxygenated hydrocarbons (aldehydes, alcohols, ketones and acids) will be produced concurrently. Dry natural gas (109,000,000 cu. ft. per day, 22% N_2) is made to react with 95% oxygen (53,000,000 cu. ft. per day) at 300 lbs. per sq. in. to produce synthesis gas. The catalyst (alkalized iron) is fluidized at 250 to 500 lbs. per sq. in. and brings about the synthesis at a temperature of 600-650°F.

C. H. Riesz

Hydrogenation

Gordon, K. THE MELCHETT LECTURE, 1947. HYDROGENATION IN THE FUEL AND CHEMICAL INDUSTRIES (3). *Petroleum* 11, 35-38 (1948) *February.*

See *Gas Abstracts* 4, 33 (1948) *February* for abstract.

Synthetic Fuels from Coal

Goddin, C. S. and Thornton, D. P., Jr. LOW-TEMPERATURE CARBONIZATION OF COAL PRODUCED MOST OF JAPS' SYNTHETIC OIL. *Petroleum Processing* 3, 121-122, 124-125, 127, 130-131 (1948) *February.*

Japan's peak production of about 717,000 barrels of synthetic gasoline and fuel oil (1944) was far short of their goal. Research on the Fischer-Tropsch synthesis was directed towards development of catalysts containing no cobalt, i.e. iron and nickel base catalysts. For atmospheric synthesis addition of boric acid to iron catalysts was useful. Natural iron catalysts were less active than precipitated iron catalysts. The three Fischer-Tropsch plants which were in operation at the end of the war were constructed according to Ruhrchemie designs and used cobalt catalyst; two other plants still under construction at the end of the war were located in Manchuria. Most of the synthetic fuel produced was obtained by coal carbonization. Much laboratory work was done which led to the development of ferric oxide, sulfur and stannous oxide as a standard catalyst. Only two plants were placed in operation and difficulties encountered are attributed to lack of alloy steels, fabrication facilities for reactor vessels and technical experience. The plants located in Fushun, Manchuria, and Agochi, Korea, are now in Russian-controlled zones.

C. H. Riesz

Synthetic Fuel Program

QUICK START ON SYNTHETICS PROGRAM

URGED BY INTERIOR SECRETARY KRUG. *Natl. Petroleum News* 40, 19 (1948) *January* 28.

A report of Mr. Krug's recommendation to Congress for an extension of the synthetic liquid fuels program and the appropriation of an additional 30 million dollars is given. He also recommended construction of three commercial size plants, one to produce oil from shale, one by coal hydrogenation and one by coal gasification and Fischer-Tropsch synthesis. He estimated that 9 billion dollars and 16 million tons of steel would be required to create 2 million bbls/day of oil capacity.

H. R. Batchelder

T.C.C. Processing

Noll, H. D. and Luntz, D. M. TCC PROCESSING OF PENNSYLVANIA OIL FRACTIONS. *Petroleum Engr.* 19, 162, 164 (1948) *January.*

See *Gas Abstracts* 4, 34 (1948) *February* for abstract.

T.C.C. Unit

Emert, F. L. LION OIL COMPANY STARTS OPERATION OF TCC UNIT. *Petroleum Refiner* 26, 85-89 (1947) *December.*

A $1,500,000 Thermofor catalytic cracking plant designed to process 4500 barrels per day of fresh gas oil was recently placed in operation at El Dorado, Arkansas, by the Lion Oil Company. A description of the plant is presented.

C. H. Riesz

7. ANALYTICAL METHODS AND TESTS

Analysis of Shale Oil Naphthas

Dinneen, G. U., Bailey, C. W., Smith, J. R., Ball, J. S. SHALE OIL NAPHTHAS: ANALYSIS OF SMALL SAMPLES BY THE SILICA GEL ABSORPTION METHOD. *Anal. Chem.* 19, 992-998 (1947) *December.*

Small samples of shale oil naphthas are analyzed by passing into a column of silica gel and removing small fractions under pressure with a suitable desorbing agent. The refractive index of each fraction is obtained and plotted against volume of filtrate to form an adsorptogram. The graph divides into plateaus, each representing a class of compounds. From this the percentages of the various classes of compounds can be calculated. Procedure and data are presented for various classes of hydrocarbons, sulfur compounds, and nitrogen compounds.

R. D. Clevenger

Carbon in Coal

Duffy, T. H. TOTAL CARBON IN BITUMINOUS COAL. *Southern Power & Industry* 66, 46-47 (1948) *February.*

The author briefly describes a graphic method for the determination of total carbon in coal. This method is based on an empirical formula relating proximate analysis, sulfur content, and heating value. A nomograph employing these data, with an accuracy of 0.28%, is presented for use with most bituminous coals.

H. Hakewill

Sulfur in Fuel Oil

SULPHUR IN FUEL OIL. *Steel* **122**, 107, 138 (1948) *February* 2.

A method is given for determining sulfur in fuel oil in a relatively short time. A procedure is outlined for combustion of small samples, about 0.1 grams, and titration of the products formed with a standard potassium iodate solution. The time for weighing and combustion of the sample is 10 minutes.

R. D. Clevenger

Surface Area Determination

Bugge, P. E. and Kerlogue, R. H. THE DETERMINATION OF THE SURFACE AREA OF POWDERS BY MEANS OF LOW-TEMPERATURE ADSORPTION ISOTHERMS. *J. Soc. Chem. Ind.* **66**, 377-380 (1947) *November.*

Known methods for making surface area measurements are briefly reviewed and the advantages and disadvantages of each are pointed out. The principle of the method for detemining surface area by means of low-temperature isotherms is described. An apparatus for making routine determinations by this method is illustrated and details of the experimental procedure and the methods of computing surface area from adsorption data are given. Possible simplifications that may be adopted to reduce the time required for a surface area determination from one day to one-half day are discussed. The authors believe that area measurements by the adsorption method are accurate to ±5%.

Abstractor's Note: This article will be most useful to anyone contemplating the construction and operation of an apparatus for determining surface area by low temperature adsorption isotherms since it contains complete working illustrations and instructions for this method.

H. Hakewill

8. GENERAL AND PHYSICAL CHEMISTRY

Alkylcyclopentanes and – hexanes

Kilpatrick, J. E., Werner, H. G., Beckett, C. W., Pitzer, K. S. and Rossini, F. D. HEATS, EQUILIBRIUM CONSTANTS AND FREE ENERGIES OF FORMATION OF THE ALKYLCYCLOPENTANES AND ALKYLCYCLOHEXANES. *J. Research Natl. Bur. Standards* **39**, 523-524 (1947) *December.*

Thermodynamic properties of cyclopentane, cyclohexane, the seven dimethylcyclohexanes, the normal alkylcyclopentanes to $C_{21}H_{42}$ and the normal alkylcyclohexanes to $C_{22}H_{44}$ have been calculated for temperatures up to 1500°K. These include the heats of formation, the free energy of formation, and the logarithm of the equilibrium constant of formation. For all but the dimethylcyclohexanes, values to 1500°K. are also given for the heat content function, the free energy function, the entropy, the heat content and the heat capacity. Free energies, equilibrium constants and concentrations for some isomerization, cyclization and hydrogenation reactions are presented in the same temperature range, graphically and tabularly.

S. Katz

Critical Temperature

CRITICAL TEMPERATURE AND MOLECULAR WEIGHT OF N-PARAFFINS. *Nature (British)* **161**, 170-171 (1948) *January* 31.

A correlation between the viscosity and the boiling point of the normal paraffins is described. The dependence of the critical temperature on molecular weight is also discussed and it is shown that T_c^3 is an additive prop-

erty for the paraffins. A theoretical explanation in terms of the internal degrees of freedom of the molecule is advanced.

S. Katz

Hydrocarbon Data

Corbin, N., Alexander, M. and Egloff, G. GAPS IN PHYSICAL CONSTANTS DATA FOR HYDROCARBONS. *J. Phys. & Colloid Chem.* 52, 387-394 (1948) *February.*

The value of correlations between structure and physical properties of hydrocarbons is discussed, and the nature of the data required for such correlations is indicated. A consideration of the extent and precision of available data leads to an indication of directions for further researches.

S. Katz

Vapor Pressure-Temperature Relationships

Wiener, H. VAPOR PRESSURE-TEMPERATURE RELATIONSHIPS AMONG THE BRANCHED PARAFFIN HYDROCARBONS. *J. Phys. & Colloid Chem.* 52, 425-430 (1948) *February.*

The boiling points of the branched-chain alkanes over a pressure range have been expressed as functions of two structural variables, w and p, by relations of the form

$$\Delta t = (k/n^2)\Delta w + b\Delta p.$$

The constants k and b are simple logarithmic functions of the pressure. The constants of the Antoine equation are related by equations of a similar form. Tests on 466 boiling points give an average deviation of 0.17° C. between calculated and observed values.

S. Katz

9. ORGANIC CHEMISTRY

C_9 Fraction of Crude Petroleum

Forziati, A. F. and Rossini, F. D. ALKYLBENZENES IN THE C_9 FRACTION FROM SEVEN REPRESENTATIVE CRUDE PETROLEUMS. *J. Research Natl. Bur. Standards* 39, 425-433 (1947) *November.*

The results of an analysis of the individual C_9 alkylbenzenes occurring in the C_9 fraction from seven representative crudes are presented. Analyses were obtained from analytical distillations by A.P.I. Research Project 6 and from spectroscopic examinations by three petroleum laboratories. It appears that the alkylbenzenes in the C_9 fraction of petroleum are present in relative amounts that are of the same magnitude for different crudes with only minor exceptions. Furthermore, the five polyalkylbenzenes found in the C_9 fractions occurred in relative amounts which would approximately be present at thermodynamic equilibrium in the gas phase of 400°C. as calculated from the most recent thermodynamic data for these compounds.

H. R. Linden

10. CHEMICAL ENGINEERING

Absorber Extraction Efficiency

Ragatz, E. G. STRAIGHT-LINE CHART DETERMINATION OF ABSORBER EXTRACTION EFFICIENCY. *Petroleum Re-*

finer 27, 83-90 (1948) *February; Oil Gas J.* 46, 78-79, 81-82, 84-85 (1948) *February* 12.

The recently proposed straight-line chart of absorber analysis has been broadened and refined with the resultant development of a highly significant over-all performance factor. This factor has been given the designation of Extraction Efficiency, and expresses the ratio (in terms of per cent) of the theooretical minimum to actual lean oil rate required to effect a 95 per cent butane recovery at any particular absorber effectiveness under any given base conditions of absorber operation. Application of this factor to a wide range of commercial units indicates the possibility of markedly improving the effectiveness of present day high pressure absorbers.

Excerpt from article
J. D. Parent, Reviewer

Flow Formula

Elenbaas, J. R. and Katz, D. L. A RADIAL TURBULENT FLOW FORMULA. *Petroleum Technol.* 11, TP-2304 (1948) *January.*

The authors have used the recent correlation of Brownell and Katz for flow of fluids through stationary beds of particles in combination with Darcy's law arranged for radial flow and have thereby provided a means of correlating pressure drops for radial flow in gas wells. Laminar flow appears to take place only at rather low flow rates so that the slope of the usual back pressure test curves deviate from unity at rather low flow rates.

J. D. Parent

Fluidization

Pettyjohn, E. S. and Christiansen, E. B. EFFECT OF PARTICLE SHAPE ON FREE SETTLING RATES OF ISOMETRIC PARTICLES. *Chem. Eng. Progress* 44, 157-172 (1948) *February.*

Free settling velocities of isometric particles were determined in white mineral oil, water, and in water-glucose solutions covering the Reynolds number range from 10^{-5} to 2×10^{4}. The coefficient of resistance, C_R, for isometric particles was found to be a function of the "sphericity", (psi) as well as Reynolds number and curves are presented showing $C_R = f$ [Re, (psi)] covering the range Re = 0.05 to 200,000. In the viscous flow range (Re < 0.05), the equation $C_R = 24/K$ Re represents the data where K = 0.843 log (psi/0.065.) This relation, rearranged in the form of Stokes' law can be applied to isometric or approximately isometric particles with an accuracy of ± 2%. In the highly turbulent range, (Re = 2000 to 200,000), C_R is quite independent of Re but was found to be empirically related to the "sphericity" as follows: $C_R = 5.31 - 4.88$(psi). Newton's law, as written below, can be applied to isometric or approximately isometric particles with an accuracy of ± 4% by inserting values of C_R calculated by the foregoing relation.

$$u = \sqrt{(4/3[\{ds\,[(rho)_p - (rho)f]\,g\}/C_R]}$$

The curves, $C_R = f$ (Re, psi) are recommended for calculations in the range Re = 0.05 to 2000. The volume coefficient "k" recommended by Heywood as a shape effect criterion was found unsatisfactory in the case of isometric particles. The fundamental relationships between particle shape, particle density and the density of the medium through which the particle is settling may be extended in future work to more compact systems in which particles are brought more closely together and the supporting fluid placed in motion. As the number of particles per unit of volume and the upward velocity of the medium through which the particles are settling increase, a gradual approach is made to lean phase and to dense phase fluidization. It is believed that the influences of particle shape, particle size and the relative densities of particles and media used may be developed for fluidized systems from an extension of the approach employed here.

E. S. Pettyjohn

Fractional Distillation and Absorption

Edmister, W. C. HYDROCARBON ABSORPTION AND FRACTIONATION PROCESS DESIGN METHODS. *Petroleum Engr.* **19**, 68, 70, 72, 74, 77, 78 (1948) *January.*

Edmister presents a method of making absorption and stripping calculations based on effective factors.

J. D. Parent

Edmister, W. C. HYDROCARBON ABSORPTION AND FRACTIONATION PROCESS DESIGN METHODS. *Petroleum Engr.* **19**, 83, 86, 88, 90, 92 (1947) *December.*

Illustrative examples and a comparison of three usual methods of calculating absorption are given. These include: (1) the series application of the fundamental equation for absorption (or stripping), (2) the effective absorption (or stripping) factors short-cut developed by Horton and Franklin wherein effective absorption factors are estimated at various points in the column, and (3) the effective absorption (or stripping) factor method of Edmister, wherein the effective absorption factors are calculated from the factors at the top and bottom plates.

C. Von Fredersdorff

Heat Transfer

Cholette, A. HEAT TRANSFER. *Chem. Eng. Progress* 44, 81-88 (1948) *January.*

This is a report of a comprehensive, experimental study of the local and average coefficients of heat transfer for the flow of air inside tubes. This investigation was undertaken to study the behavior of the heat-transfer coefficient when the air flow was in the transition range. Local coefficients for a given Reynolds number, N_{Re}, were always highest for the starting section of the tube. Except for the transition region ($2{,}200 < N_{Re} < 8{,}000$), where the local coefficient went through a minimum, the local coefficient was substantially independent of the length-diameter ratio, X/D, beyond the first ten diameters. The author recommends certain correlations for obtaining the average coefficient for cases when the total length diameter ratio, L/D, is between 10.5 and 63. If one changes his symbols to the common dimensionless ratios, Reynolds number, N_{Re}; Nusselt number, N_{Nu}, and Prandtl number N_{Pr}, his correlations are of the form: $(N_{Nu})/(N_{Re} \times N_{Pr}) = C_1 (N_{Re})^m (L/D)^n$ where C_1, m and n are constants for certain ranges of Reynolds number.

W. M. Dow

Heat Transfer

Rumford, F. HEAT TRANSFER THROUGH BOILING LIQUID FILMS. *J. Soc. Chem. Ind.* **66**, 309-312 (1947) *September.*

Heat flow from a metal wall to a boiling fluid was measured for distilled water, ethyl alcohol, nitric acid, and toluene. Data is given to show that in a vertical tube evaporator, boiling is distributed the entire length of the tube and where more than 10% of the feed liquid is converted to vapor the rate of heat transfer is not affected by the mass velocity.

H. Dirksen

High Velocity Vaporizers

Comings, E. W., Adams, C. H. and Shippe, E.

D. HIGH VELOCITY VAPORIZERS. *Ind. Eng. Chem.* 40, 74-76 (1948) *January.*

A method for vaporizing relatively high boiling or thermally unstable liquids is described. The liquid is introduced as a jet into a high velocity hot gas stream. The liquid is atomized to drop less than 100 microns in diameter, and high rates of heat transfer are effected. The time of exposure of the liquid to high temperature is of the order of a few milliseconds.

O. Bloomer

Liquid Atomization

Lewis, H. C., Edwards, D. G., Goglia, M. J., Rice, R. I. and Smith, L. W. ATOMIZATION OF LIQUIDS IN HIGH VELOCITY GAS STREAMS. *Ind. Eng. Chem.* 40, 67-74 (1948) *January.*

Literature is reviewed and existing data correlated for determinations of average drop diameter and distribution of drop sizes for both gas atomizing and liquid spray nozzles. The results of tests on venturi atomizers with throat diameters of 0.107 in., 0.500 in., and 3.34 in. are included.

O. Bloomer

Pressure Drop

Boucher, D. F. and Lapple, C. E. PRESSURE DROP ACROSS TUBE BANKS. *Chem. Eng. Progress* 44, 117-132 (1948) *February.*

A comparison of the data obtained and the existing methods of correlation in regard to pressure drop with turbulent flow across, staggered, and in line tube banks is offered. The variables affecting pressure drop and those considered in the existing methods of correlation with the deviation found between the data and various methods are fully discussed.

H. Dirksen

Ternary Distillation

White, R. R. CALCULATION OF PLATE COLUMNS FOR TERNARY DISTILLATION. *Petroleum Processing* 3, 143, 146-147, 149-150, 152, 153 (1948) *February.*

A simple and straightforward presentation is given of an analysis of the design calculations for complete columns distilling ternary mixtures with emphasis on the limiting case of minimum reflux with illustrating problems.

H. Dirksen

Thermodynamics

Edmister, W. C. APPLICATIONS OF THERMODYNAMICS TO HYDROCARBON PROCESSING—PART VII—HYDROCARBON PROPERTIES FOR DERIVATIONS. *Petroleum Refiner* 27, 74-82 (1948) *January.*

This installment of the series begins the treatment of the thermodynamic properties of hydrocarbons and hydrocarbon mixtures. Characterization factors, employing two properties of the hydrocarbon mixture under consideration are used in place of exact definition of the hydrocarbons. These properties may be gravity, viscosity, boiling point or aniline number. Literature sources for properties of pure hydrocarbons are also discussed, and a brief comparison of the PVT properties of pure substances and mixtures is offered.

S. Katz

Unit Operations Review

CHEMICAL ENGINEERING UNIT OPERATIONS. *Ind. Eng. Chem.* 40, 2-56 (1948) *January.*

Recent advances in various engineering unit operations are presented in accordance with the practice established several years ago by *Industrial and Engineering Chemistry* of presenting such summaries annually.

J. D. Parent

11. PROCESS EQUIPMENT AND INSTRUMENTATION

Fractionating Column Control

Gallagher, G. G. CONTROL OF NARROW-BOILING-RANGE FRACTIONATING COLUMNS. *Oil Gas J.* 46, 85, 140 (1948) *February* 5.

In narrow-boiling-range fractionating columns a charge of 1% in the operating pressure or temperature changes the product composition as much as 3 or 4%. Using temperature control equipment the accuracy desired could not be obtained. As a result a vapor pressure control apparatus was devised which, with a 1% change in the operating pressure, results in only a .4% change in composition. A description of the instrument is given.

H. Dirksen

Heat Exchanger

Armstrong, R. M. HEAT EXCHANGER FEATURES UNUSUAL FIN DESIGN. *Refrig. Eng.* 55, 47-48 (1948) *January.*

The heat exchanger discussed in this article consists of two tubes, one inside the other, the inner tube being equipped with longitudinal fins welded to its outer surface. Vapor flows through the space between the outer tube and the finned inner tube, the fins making up for the relatively low film coefficient of heat transfer by supplying a larger heat transfer area. Pressure drop is low since the fins are straight and smooth. The liquid passes through the inner tube equipped with a filler rod to reduce the liquid charge. This type of heat exchanger has recently been made available for refrigeration equipment for drying and superheating suction vapor going from evaporator to compressor by the use of high pressure liquid going from receiver to expansion valve. It is the application rather than the design which is new; longitudinally finned tubes were first used about 10 years ago, principally in the petroleum refining industry.

J. J. First

12. MATERIALS OF CONSTRUCTION

Aluminum Pipe Lines

Bell, H. S. and Holmes, C. K. ALUMINUM PIPE LINES FOR OIL AND GAS. *World Oil* 127, 169-172, (1948) *February.*

Aluminum pipe is available in sizes up to 12-3/4" O/D. Metallurgical and economic considerations are presented to show that its usage may be only slightly more expensive than for steel. Since it is available it is suggested as a possible solution of the present problem of obtaining line pipe.

J. D. Parent

Carbon As a Refractory

Cory, M. T. and Thacher, F. B. CARBON—A BLAST FURNACE REFRACTORY. *Blast Furnace Steel Plant* 35, 1482-1487 (1947) *December.*

Applied initially in Germany, carbon and graphite as a blast furnace refractory is finding wide application in the United States. Not wetted by either metal or slag, carbon and graphite have other advantages among which are a low coefficient of thermal expansion, wide range in thermal conductivity, high compressive strength and high resistance to erosion. Carbon is utilized as a paste in laying hearth bottoms and as blocks and cylindrical shapes in lining of blast furnaces and crucibles, and can be used in conjunction with fireclay brick to decrease external heat losses. Illustrative diagrams and thermal expansion and conductivity data are included.

C. Von Fredersdorff

Corrosion Inhibitors

Nicholson, J. T. RECENT DEVELOPMENTS IN THE USE OF CORROSION INHIBITORS. *Corrosion* 4, 32-36 (1948) *January.*

In this article, different types of inhibitors used as a corrosion preventative in aqueous solution are discussed briefly. The author stresses the necessity of carefully studying all the factors causing corrosion before choosing the correct type of inhibitor.

S. Mori

Chimney Liner Corrosion

Johnson, G. B. CHIMNEY LINER CORROSION RESULTING FROM GAS-FIRED FURNACES. *Corrosion* 4, 15-23 (1948) *January.*

Different materials for chimney liners were tried out in Minneapolis, and the 2-S 1/2 hard aluminum was found to be the least corrosive of the tested liners. Best results were obtained when the water boiler bottoms were kept free from scale, and the stack temperature was kept above 400°F.

S. Mori

Corrosion of Underground Pipe

Cramer, A. H. GAS UTILITY UNDERGROUND PIPE CORROSION MITIGATION PRACTICES. *Corrosion* 4, 72-82 (1948) *February.*

The introduction of steel pipes for gas mains necessitated the use of a coating and wrapping process on pipes as means of corrosion protection; however, after a period, breaks may occur in the coating which may encourage corrosion. There are many instruments that may be used to determine potential corrosion spots or breaks, but the recently developed Pearson Fault Locator seems to be the most promising.

S. Mori

Rust Preventives

Sellei, H. RUST PREVENTIVES—HOW THEY WORK, WHAT THEY CONTAIN. *Chem. Ind.* 62, 62-64 (1948) *January.*

A brief review on the nature of ready removable metal surface preservatives, the history of their use, and the necessity of further investigations is found in this article. Also included are various types of chemical additives and their base materials.

S. Mori

Seamless Line Pipe

Wilder, A. B. and Tyson, J. D. METALLURGICAL PROPERTIES OF HIGH YIELD STRENGTH SEAMLESS LINE PIPE. *World Oil* 127, 209-210 (1947) *December.*

Recently a steel of 0.40% maximum carbon and 1.40% maximum manganese has been used to produce a new grade of seamless line pipe with a minimum yield strength of 52,000 psi and 75,000 psi minimum tensile strength. The current practice in the manufacture of seamless line pipe has been limited to 0.30% maximum carbon, 1.25% maximum manganese with a minimum yield strength of 42,000-45,000 psi. The increase in minimum yield strength from 42,000-45,000 psi to 55,000 psi involved a number of problems in testing due to the appreciable increase in strength characteristics. Methods of testing are given along with modifications that were necessary. The authors conclude that under certain conditions it may be more desirable to increase the carbon content in preference to manganese in order to obtain higher yield strength material while other results indicate that under certain conditions manganese may be the controlling factor.

E. Strong

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